CLAIMS

1. A method for injection molding a layer of phase change material around a surface of each of a plurality of identical hard disc drive components comprising:

a) providing a plurality of identical hard disc drive components;

b) placing one of said plurality of identical hard disc drive components in a mold cavity of an injection molding machine having a controllable fill rate and a controllable injection pressure;

c) closing said mold cavity;

d) injecting a molten phase change material into said mold cavity at fill rates and injection pressures;

e) monitoring pressure in the mold cavity;

f) controlling the fill rate of said molten phase change material to obtain said hard disc drive component with the phase change material thereon; and

g) repeating steps b)-f) to produce said plurality of components each having a substantially uniform resonance spectrum.

2. The method of claim 1 wherein the pressure is monitored at a runner to the mold cavity, a beginning-of-fill point and an end-of-fill point.

3. The method of claim 1 further comprising the step of controlling the injection pressure of said molten phase change material to help obtain said hard

disc drive components with the phase change material thereon, having a substantially uniform resonance spectrum.

4. The method of claim 1 wherein the injection is carried out until predetermined beginning-of-fill and end-of-fill pressures are reached.

5. The method of claim 1 wherein the fill rate and injection pressure are controlled to produce a predetermined pressure gradient across the mold cavity.

6. The method of claim 5 wherein after said predetermined pressure gradient is obtained, said molten material is held in said mold cavity until said material cools and solidifies.

7. The method of claim 2 wherein the pressure at the end-of-fill point inside the mold cavity is measured by a pressure transducer associated with said end-of-fill point.

8. The method of claim 7 wherein the pressure transducer is located within the last ten percent of the cavity to fill with molten material.

9. The method of claim 2 wherein a pressure transducer is placed inside the mold cavity at the beginning-of-fill point.

10. The method of claim 9 wherein the pressure transducer is located within the first ten percent of the cavity to fill with molten material.

11. The method of claim 1 wherein a stroke sensor measures the fill rate of molten material.

12. The method of claim 7 wherein a controller controls the injection pressure based on signals transmitted by said pressure transducers to the

controller.

13. The method of claim 11 wherein a controller controls the fill rate based upon signals transmitted by said stroke sensor.

14. The method of claim 13 wherein the controller starts and stops the flow of molten material into said cavity by opening and closing a valve gate associated with said cavity.

15. The method of claim 1 wherein said one of said plurality of identical hard disc drive components are selected from the group consisting of spindle motors, voice coil motors, and wire wound motors.

16. The method of claim 1 wherein said identical hard disc drive components are electromagnetic devices.

17. The method of claim 1 wherein said injection of said molten phase change material has a maximum flow rate above about 25 cm^3/sec.

18. The method of claim 1 wherein said plurality of said hard disc drive components comprise at least one hundred components, said at least one hundred components having a median first order frequency and wherein each of said at least one hundred hard disc drive components with a phase change material thereon has a first order frequency that is within about three hundred Hertz of said median first order frequency.

19. The method of claim 18 wherein each of said at least one hundred hard disc drive components with a phase change material thereon has a first order frequency that is within about one hundred Hertz of said median first order frequency.

20. The method of claim 18 wherein each of said at least one hundred hard disc drive components with a phase change material thereon has a first order frequency that is within about thirty Hertz of said median first order frequency.

21. The method of claim 1 wherein the resonance spectra of said plurality of hard disc drive components with phase change material thereon have a standard deviation of first order resonance frequency that is at least about twenty five percent less than the standard deviation of the first order resonance frequency for the same number of the same components over-molded with an injection molding process wherein only the injection pressure and either the injection time or stroke of an extrusion screw are controlled.

22. The method of claim 1 wherein the resonance spectra of said plurality of hard disc drive components with phase change material thereon have a standard deviation of first order resonance frequency that is at least about fifty percent less than the standard deviation of the first order resonance frequency for the same number of the same components over-molded with an injection molding process wherein only the injection pressure and either the injection time or stroke of an extrusion screw are controlled.

23. The method of claim 1 wherein said one of said plurality of hard disc drive components is placed in a mold with one or more additional components used in a single hard disc drive and a layer of phase change material is injection molded thereon.

24. The method of claim 23 wherein said one or more hard disc drive components are substantially encapsulated with said phase change material.

25. The method of claim 24 wherein said one of said plurality and said one or more additional hard disc drive components are unitized by a monolithic body of said phase change material.

26. The method of claim 1 wherein the phase change material comprises a thermoplastic material or a thermosetting material.

27. The method of claim 1 wherein the phase change material includes ceramic particles.

28. The method of claim 1 wherein the phase change material has a coefficient of linear thermal expansion of less than $2x10^{-5}$ in/in/°F throughout the range of 0°F to 250°F.

29. The method of claim 1 wherein the phase change material has a coefficient of linear thermal expansion in the X, Y and Z directions, wherein the coefficient of linear thermal expansion is lowest in the X direction, and wherein the coefficient of linear thermal expansion in the Y and Z directions is no more than four times the coefficient of linear thermal expansion in the X direction.

30. The method of claim 1 wherein the injection molding machine comprises a multi-cavity mold machine.

31. The method of claim 25 wherein the density of the monolithic body is substantially uniform.

32. A hard disc drive component made by the method of claim 1.

33. An electronic device comprising the hard disc drive component of claim 32.

34. A method of manufacturing hard disc drives having a reproducible

resonance spectrum comprising:

a) providing a plurality of identical hard disc drive component sets, wherein each of said sets consists of components that are used in a single hard disc drive;

b) placing and positioning one of said plurality of hard disc drive component sets in a mold cavity of an injection molding machine;

c) closing said mold cavity;

d) monitoring the pressure inside the mold cavity at an end-of-fill point;

e) injecting a molten phase change material into said mold cavity to a pre-determined set point pressure; and

f) repeating steps b)-e) to produce a plurality of hard disc drives each having a substantially uniform resonance spectrum.

35. The method of claim 34 wherein after said injecting of molten phase change material, said molten phase change material is held in said mold cavity until said material cools and solidifies into a monolithic body.

36. The method of claim 34 wherein a controller starts and stops flow of the molten phase change material into said cavity by opening and closing a valve gate associated with said cavity.

37. The method of claim 34 wherein the pressure at the end-of-fill point inside the mold cavity is measured by a pressure transducer associated with said end-of-fill point.

38. The method of claim 34 wherein a pressure transducer is also

located inside the mold cavity at a beginning-of-fill point.

39. The method of claim 34 wherein said set of hard disc drive components comprises a stator, voice coil motor and a base plate.

40. The method of claim 34 wherein said plurality of said hard disc drive component sets comprise at least one hundred component sets, said at least one hundred component sets having a median first order frequency and wherein each of said at least one hundred hard disc drive component sets with a phase change material thereon has a first order frequency that is within about three hundred Hertz of said median first order frequency.

41. The method of claim 40 wherein each of said at least one hundred hard disc drive component sets with a phase change material thereon has a first order frequency that is within about one hundred Hertz of said median first order frequency.

42. The method of claim 40 wherein each of said at least one hundred hard disc drive component sets with a phase change material thereon has a first order frequency that is within about thirty Hertz of said median first order frequency.

43. The method of claim 34 wherein the resonance spectra of said plurality of hard disc drive component sets with phase change material thereon have a standard deviation of first order resonance frequency that is at least about twenty five percent less than the standard deviation of first order resonance frequency for the same number of the same component sets over-molded with an injection molding process wherein only the injection pressure and either the

injection time or stroke of an extrusion screw are controlled.

44. The method of claim 34 wherein the resonance spectra of said plurality of hard disc drive component sets with phase change material thereon have a standard deviation of first order resonance frequency that is at least about fifty percent less than the standard deviation of first order resonance frequency for the same number of the same component sets over-molded with an injection molding process wherein only the injection pressure and either the injection time or stroke of an extrusion screw are controlled.

45. The method of claim 34 wherein said set of hard disc drive components are unitized by said monolithic body.

46. A method for injection molding a layer of phase change material around a surface of each of a plurality of identical motor components comprising:

a) providing a plurality of identical motor components;

b) placing one of said plurality of identical motor components in a mold cavity of an injection molding machine having a controllable fill rate and a controllable injection pressure;

c) closing said mold cavity;

d) injecting a molten phase change material into said mold cavity at a fill rate and injection pressure;

e) monitoring pressure in the mold cavity;

f) controlling either the fill rate or injection pressure or both of said molten phase change material to obtain said motor component with the phase change material thereon; and

g) repeating steps b)-f) to produce said plurality of motor components each having a substantially uniform resonance spectrum.

47. The method of claim 46 wherein the pressure is monitored at an injection to the mold cavity, a beginning-of-fill point and an end-of-fill point.

48. The method of claim 47 further comprising the step of controlling the injection pressure of said molten phase change material to help obtain said motor components with the phase change material thereon.

49. The method of claim 46 wherein the injection is carried out until predetermined beginning-of-fill and end-of-fill pressures are reached.

50. The method of claim 47 wherein the pressure at the end-of-fill point inside the mold cavity is measured by a pressure transducer associated with said end-of-fill point.

51. The method of claim 46 wherein a plurality of motor component sets are provided to produce a motor with a phase change material on a portion of the surface of said motor, wherein each motor component set comprises motor components that are used in a single motor.

52. The method of claim 51 wherein said motor is a motor selected from the group consisting of motors for use in automobiles or appliances or power tools.

53. The method of claim 46 wherein said plurality of said motor components comprise at least one hundred components, said at least one hundred components having a median first order frequency and wherein each of said at least one hundred motor components with a phase change material thereon has a

first order frequency that is within about three hundred Hertz of said median first order frequency.

54. The method of claim 53 wherein each of said at least one hundred motor components with a phase change material thereon has a first order frequency that is within about one hundred Hertz of said median first order frequency.

55. The method of claim 53 wherein each of said at least one hundred hard disc drive components with a phase change material thereon has a first order frequency that is within about thirty Hertz of said median first order frequency.

56. The method of claim 46 wherein the resonance spectra of said plurality of motor components with phase change material thereon have a standard deviation of first order resonance frequency that is at least about twenty five percent less than the standard deviation of first order resonance frequency for the same number of the same components over-molded with an injection molding process wherein only the injection pressure and either the injection time or stroke of an extrusion screw are controlled.

57. The method of claim 46 wherein the resonance spectra of said plurality of motor component sets with phase change material thereon have a standard deviation of first order resonance frequency that is at least about fifty percent less than the standard deviation of first order resonance frequency for the same number of the same components over-molded with an injection molding process wherein only the injection pressure and either the injection time or stroke of an extrusion screw are controlled.

58. The method of claim 1 wherein the phase change material has a coefficient of linear thermal expansion of less than $2x10^{-5}$ in/in/°F throughout the range of 0°F to 250°F.

59. The method of claim 1 wherein the phase change material has a coefficient of linear thermal expansion in the X, Y and Z directions, wherein the coefficient of linear thermal expansion is lowest in the X direction, and wherein the coefficient of linear thermal expansion in the Y and Z directions is no more than four times the coefficient of linear thermal expansion in the X direction.

60. A method of reducing sympathetic system wide resonances of components in a hard disc drive comprising:

a) providing a hard disc drive component;

b) determining a desired resonance spectrum of said hard disc drive component;

c) placing said hard disc drive component in a mold cavity of an injection molding machine having a controllable fill rate and a controllable injection pressure;

d) closing said mold cavity;

e) injecting a molten phase change material into said mold cavity at a fill rate and an injection pressure;

f) monitoring the pressure in the mold cavity; and

g) controlling the fill rate of said molten phase change material and injection pressure to obtain said hard disc drive component with the phase change material thereon, having said desired resonance spectrum.

61. The method of claim 60 wherein said desired resonance spectrum is achieved by tuning the fill rate and pressure to a predetermined set-point fill rate and a predetermined set-point pressure.

62. A method for injection molding a layer of phase change material around a surface of a plurality of identical hard disc drive components comprising:

a) providing a plurality of hard disc drive components;

b) placing one of said plurality of hard disc drive components in a mold cavity of an injection molding machine having a controllable fill rate and a controllable injection pressure;

c) closing said mold cavity;

d) injecting a molten phase change material into said mold cavity at desired fill rates and injection pressures;

e) monitoring pressure in the mold cavity;

f) controlling the injection pressure of said molten phase change material to obtain said hard disc drive component with the phase change material thereon having a reproducible resonance spectrum; and

g) repeating steps b)-f) to produce said plurality of components each having a substantially uniform resonance spectrum.

63. The method of claim 62 wherein the pressure is monitored at a runner to the mold cavity, a beginning-of-fill point and an end-of-fill point.

64. The method of claim 62 further comprising the step of controlling the fill rate of said molten phase change material to obtain said hard disc drive components with the phase change material thereon.

65. The method of claim 62 wherein the injection is carried out until predetermined beginning-of-fill and end-of-fill pressures are reached.

66. The method of claim 62 wherein the pressure at the end-of-fill point inside the mold cavity is measured by a pressure transducer associated with said end-of-fill point.

67. The method of claim 62 wherein said plurality of said hard disc drive components comprise at least one hundred components, said at least one hundred components having a median first order frequency and wherein each of said at least one hundred hard disc drive components with a phase change material thereon has a first order frequency that is within about three hundred Hertz of said median first order frequency.

68. The method of claim 67 wherein each of said at least one hundred hard disc drive components with a phase change material thereon has a first order frequency that is within about one hundred Hertz of said median first order frequency.

69. The method of claim 67 wherein each of said at least one hundred hard disc drive components with a phase change material thereon has a first order frequency that is within about thirty Hertz of said median first order frequency.

70. The method of claim 62 wherein the resonance spectra of said plurality of hard disc drive components with phase change material thereon have a standard deviation of first order resonance frequency that is at least about twenty five percent less than the standard deviation of first order resonance frequency for the same number of the same components over-molded with an injection molding

process wherein only the injection pressure and either the injection time or stroke of an extrusion screw are controlled.

71. The method of claim 62 wherein the resonance spectra of said plurality of hard disc drive components with phase change material thereon have a standard deviation of first order resonance frequency that is at least about fifty percent less than the standard deviation of first order resonance frequency for the same number of the same components over-molded with an injection molding process wherein only the injection pressure and either the injection time or stroke of an extrusion screw are controlled.

72. The method of claim 62 wherein the phase change material has a coefficient of linear thermal expansion of less than $2x10^{-5}$ in/in/°F throughout the range of 0°F to 250°F.

73. The method of claim 1 wherein the phase change material has a coefficient of linear thermal expansion in the X, Y and Z directions, wherein the coefficient of linear thermal expansion is lowest in the X direction, and wherein the coefficient of linear thermal expansion in the Y and Z directions is no more than four times the coefficient of linear thermal expansion in the X direction.

74. A method of injection molding hard disc drive components having a reproducible resonance spectrum comprising:

a) providing at least one hundred identical hard disc drive components; and

b) over-molding a monolithic body of phase change material on a surface of said hard disc drive components using an injection molding process,

process, wherein said components with a phase change material thereon have a median first order frequency and wherein each of said at least one hundred hard disc drive components with a phase change material thereon has a first order frequency that is within about one hundred Hertz of said median first order frequency.

75. A method of injection molding hard disc drive components having a reproducible resonance spectrum comprising:

a) providing at least one hundred identical hard disc drive components, wherein each of said components has a resonance spectrum; and

b) over-molding a monolithic body of phase change material on a surface of said hard disc drive components using an injection molding process, wherein the resonance spectra of said at least one hundred hard disc drive components with phase change material thereon have a standard deviation of first order resonance frequency that is at least about fifty percent less than the standard deviation of first order resonance frequency for the same number of the same components over-molded with an injection molding process wherein only injection pressure and either injection time or stroke of an extrusion screw are controlled.